

SWM

U.S. Forest Service
Region 6

HOS-4

5230
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DOIY

BIOLOGICAL EVALUATION
Western Spruce Budworm Populations
on the
Tonasket Ranger District, Okanogan National Forest

INTRODUCTION

The new western spruce budworm outbreak on the Tonasket Ranger District is the first to be detected on the southern part of this District. The last budworm outbreak in 1947 was confined to timber stands within the central and northern portions of the District. Two areas of budworm defoliation, totaling 120 acres, were mapped during the 1976 Cooperative Insect Aerial Detection Survey. Additional new budworm-defoliated areas were discovered on the Colville Indian Reservation just south of the District boundary.

The Tonasket Ranger District was included in the September 1976 fall egg mass survey. The results and recommendations are included in this evaluation.

TECHNICAL INFORMATION

Causal Agent: Western spruce budworm, *Choristoneura occidentalis*, Freeman.

Host Trees: Douglas-fir, *Pseudotsuga menziesii* (Mirb) Franco
Grand fir, *Abies grandis* (Dougl.) Lindl.
Engelmann spruce, *Picea engelmanni*, Parry
Western larch, *Larix occidentalis*, Nutt.
Ponderosa pine, *Pinus ponderosa*, Laws
Lodgepole pine, *Pinus contorta*, Dougl.

Type of Damage: The western spruce budworm has one generation per year. Eggs are deposited on the underside of host tree needles from late July to mid-August depending on tree location and climatic conditions. Ten days after deposition these eggs hatch and the first instar larvae migrate from the needles to the larger branches or the main tree bole where they hibernate. No feeding takes place during this phase of the life cycle. The destructive stage begins early the following spring before bud break when these larvae transform into second instars, leave their overwintering sites for the terminal branchlets, and mine into last season's needles causing minor damage. After the new buds swell and begin to expand, the larvae leave the older mined needles and burrow into the new buds causing more serious damage. Both reproductive and vegetative buds are affected. Feeding continues on the newly developing needles until the larvae mature and pupate in webby, partially-eaten needles. Pupation occurs from late June to mid-July. Mature adults emerge from late July to August to begin a new cycle.

Biological Data: Abnormal climatic conditions which prevailed in the Northwest during 1976 extended into north-central Washington State. Consistent cool, moist weather continued into early summer affecting normal tree bud development. Cool weather patterns developed throughout the summer. It is not clear what impact these weather conditions had on the Tonasket Ranger District's budworm populations. However, further evaluations during 1977 will consider these influences on budworm population trend.

Outbreak Location and Extent: Tonasket is the eastern most Ranger District on the Okanogan National Forest. A total of 120 acres of light budworm defoliation divided between two areas are located about 2 miles northwest and northeast of Bailey Mountain (T. 35 N., R. 29 E., sec. 23 and T. 35 N., R. 30 E., sec. 17). These two areas are within 4 miles of new budworm defoliation on the Colville Indian Reservation adjacent to the Tonasket District boundary.

METHODS

Aerial Detection: The western spruce budworm outbreak on the Tonasket Ranger District was sketch-mapped on a half-inch-mile map during August from a fixed-wing aircraft. The only defoliation category mapped was light (L) which refers to defoliation in tree tops only and the lower portions of the tree crowns show no discoloration due to budworm feeding.

Fall Egg Mass Survey: Seventeen plots were sampled for western spruce budworm egg masses in Oregon. These plots were located in past budworm outbreak areas, current areas of defoliation, and potential problem areas.

Three trees were selected at each plot. Tree sizes ranged from 7.5 to 15.0 meters (25 to 50 feet) and only dominant or codominant Douglas-fir or true firs were sampled. No overtopped trees were selected for sampling. Two, 70 cm branches (27.5 inches) were removed from opposite sides of each sample tree at mid-crown using a pole pruner with an attached basket near the cutting head. Branch samples were lowered to the ground where foliage area measurements were recorded. Each branch after measurement was cut into smaller lengths and placed in separate marked paper bags. In the field, efforts were made to temporarily store these bags in cool lockers at the various Ranger Districts. At the end of the week, they were collected and transported to the laboratory in Portland, Oregon and stored in a walk-in refrigerator until the foliage was examined for egg masses.

Laboratory Procedures: A three-person team worked with the foliage as it came in from the field. Two would examine each bag of foliage separately, remove needles containing old, new, hatched, unhatched, or parasitized egg masses together with any other extraneous doubtful material, place these in one container for each branch, and the entomologist would separate this material into the proper categories. These data were then summarized for each plot and Forest.

Data Analysis: New egg mass density is expressed as egg mass number per square meter and 1,000 square inches of foliage. This was calculated for each branch sample as follows:

Square foliage area in meters or inches = $\frac{\text{length} \times \text{width}}{2}$

Egg masses per square meter or 1,000 inches = $\frac{\text{egg mass number} \times 1,000}{\text{foliage area in meter}^2 \text{ or inches}^2}$

Mean egg mass density for each plot was calculated in a multistage program which used egg mass densities over branches and trees (\bar{y}) and egg mass densities over branches, trees, and plots (y). These computations are as follows:

$$\text{Egg mass density per plot} = \bar{y} = \frac{M}{\sum_{l=1}^M} \frac{K}{\sum_{j=1}^K} y_{lj}/mk$$

$$\text{Egg mass density per unit (Forest)} = \bar{y} = \frac{N}{\sum_{i=1}^N} \bar{y}_i/n$$

n = number of plots (first stage unit)

m = number of trees (second stage unit)

k = number of branches (third stage unit)

All accumulated egg mass data including these computations will be used in the MUST computer program.¹

RESULTS

Western spruce budworm egg mass density per square meter and per 1,000 square inches of foliage are listed below by plot:

New Egg Mass Density

Sample Plot	:	Square Meter	:	1,000 Sq. Inches
1		0.0		0.0
2		1.2		0.8
3		0.6		0.4
4		1.8		1.1
5		0.0		0.0
6		0.0		0.0
7		0.0		0.0
8		0.0		0.0
9		0.0		0.0
10		0.0		0.0
11		0.0		0.0
MEAN		0.3		0.2

¹Hazard, J.W. and L.E. Stewart. 1974. Planning and processing multistage samples with computer program--MUST. USDA, Forest Service, Research Paper PNW-11.

Defoliation Prediction: Anticipated defoliation based on average new egg mass density was described by Carolin and Coulter.^{2/}

Average Egg Masses		:	Defoliation	
Per Meter	: Sq. Inches	: Category	Percent	:
0.0 - 2.0	0.0 - 1.3	Very Light	0 - 15	
2.1 - 5.4	1.4 - 3.5	Light	16 - 25	
5.5 - 13.8	3.6 - 8.9	Moderate	26 - 50	
13.9 - 27.4	9.0 - 17.7	Heavy	51 - 90	
27.5 +	17.8 +	Very Heavy	91 - 100	

DISCUSSION

New budworm egg masses were found on foliage from plots 2, 3, and 4 which are located outside the mapped defoliated areas. Foliage collected at plots 5, 6, 7, and 8, which are within or adjacent to areas of budworm damage, supported no new egg masses. Based on overall egg mass density, budworm feeding during 1977 is expected to be light and no permanent tree damage is anticipated.

RECOMMENDATIONS

Abnormal climatic conditions during 1977 will further influence budworm population trends. To determine population direction on the Tonasket Ranger District, the following budworm monitoring and survey methods will be used:

1. Ground Surveys
 - a. Analysis of the eight defoliator monitoring plots will be made as soon as larval samples are received from the District.
 - b. The eleven established budworm plots will be resampled during the 1977 fall egg mass survey and additional plots will be located in new defoliated areas.
2. Insect aerial detection survey maps of the Tonasket Ranger District and the northwest corner of the Colville Indian Reservation will be studied to locate additional sampling plots in areas of new budworm damage which will be included in the 1977 fall egg mass survey.

Direct control during 1977 is not recommended.

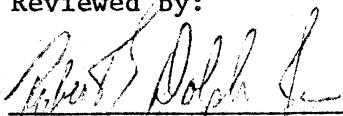
2/Carolin, V.M. and W.K. Coulter, 1972. Sampling populations of western spruce budworm and predicting defoliation on Douglas-fir in eastern Oregon. USDA, Forest Service, Research Paper, PNW-149.

Prepared by:



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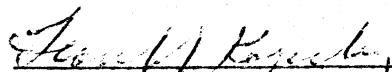


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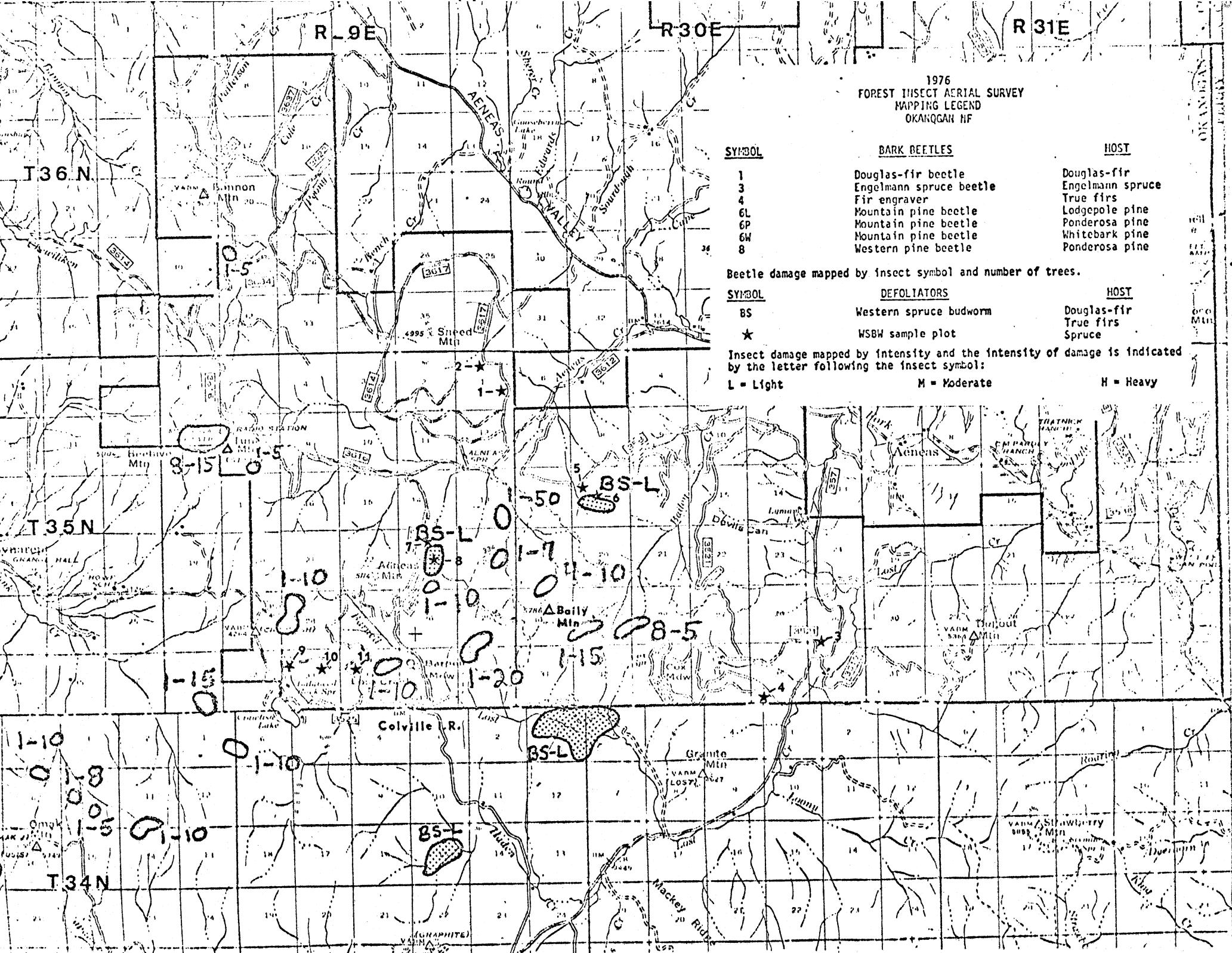
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1976
FOREST INSECT AERIAL SURVEY
MAPPING LEGEND
OKANOGAH NF

SYMBOL

Douglas-fir beetle
Engelmann spruce beetle
Fir engraver
Mountain pine beetle
Mountain pine beetle
Mountain pine beetle
Western pine beetle

HOST

Douglas-fir
Engelmann spruce
True firs
Lodgepole pine
Ponderosa pine
Whitebark pine
Ponderosa pine

Beetle damage mapped by insect symbol and number of trees.

SYMBOL

DEFOLIATORS
Western spruce budworm
WSBW sample plot

HOST

Douglas-fir
True firs
Spruce

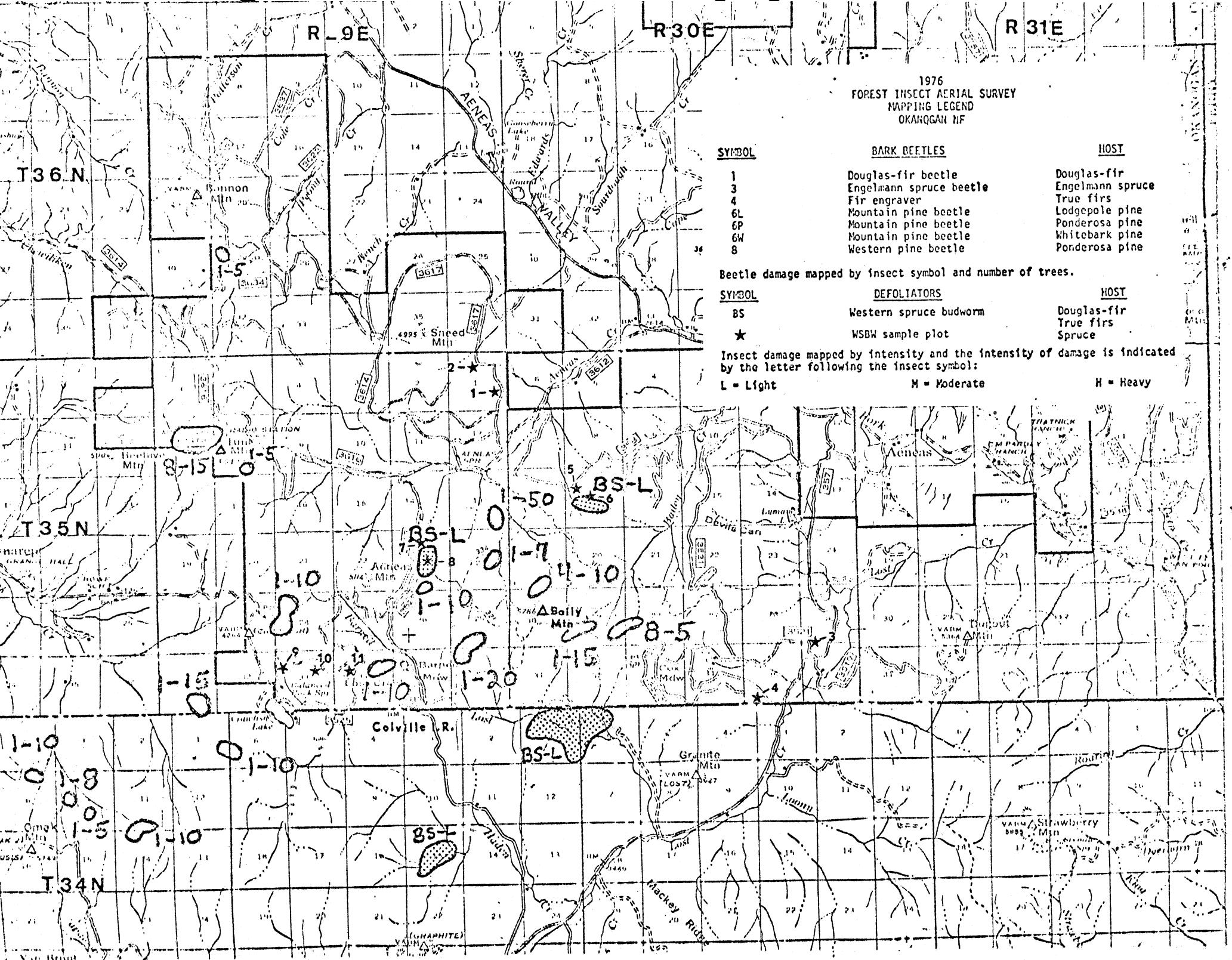
Insect damage mapped by intensity and the intensity of damage is indicated by the letter following the insect symbol:

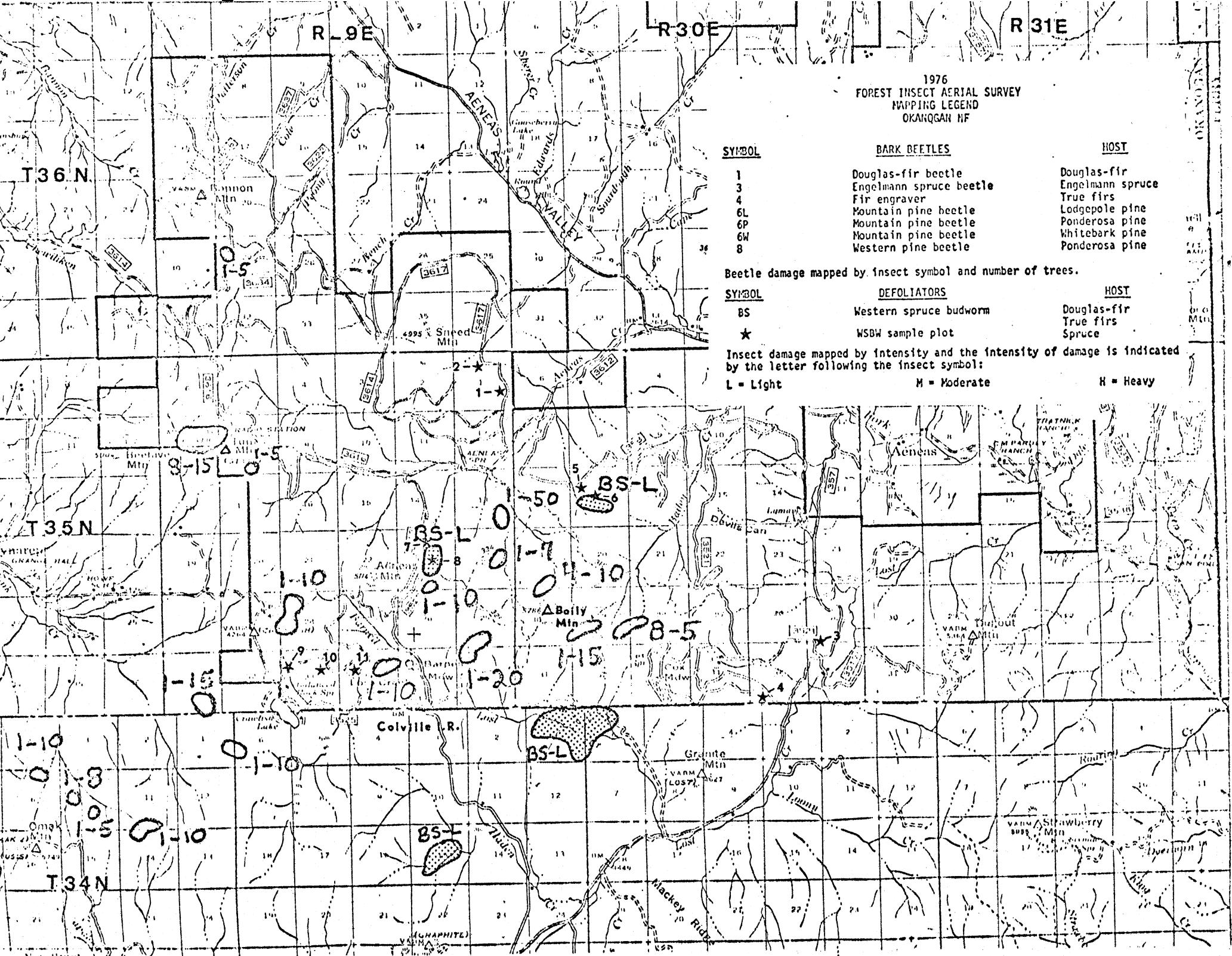
L = Light

M = Moderate

H = Heavy

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1976
FOREST INSECT AERIAL SURVEY
MAPPING LEGEND
OKANOGAN NF

SYMBOL

1	Douglas-fir beetle
3	Engelmann spruce beetle
4	Fir engraver
6L	Mountain pine beetle
6P	Mountain pine beetle
6W	Mountain pine beetle
8	Western pine beetle

HOST

Douglas-fir
Engelmann spruce
True firs
Lodgepole pine
Ponderosa pine
Whitebark pine
Ponderosa pine

BARK BEETLES

Douglas-fir beetle
Engelmann spruce beetle
Fir engraver
Mountain pine beetle
Mountain pine beetle
Mountain pine beetle
Western pine beetle

HOST

Beetle damage mapped by insect symbol and number of trees.

SYMBOL

DEFOLIATORS

HOST

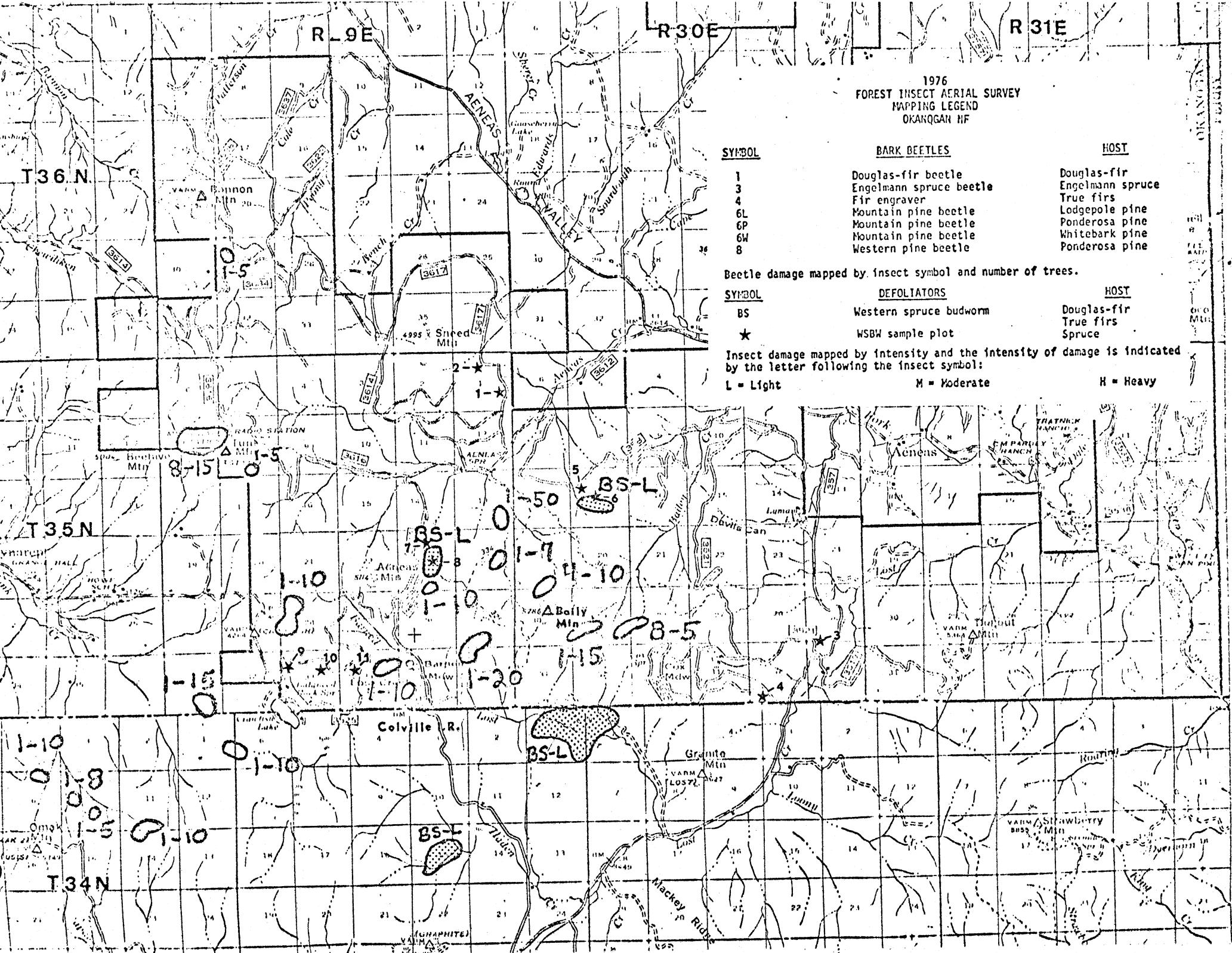
Douglas-fir
True firs
Spruce

Insect damage mapped by intensity and the intensity of damage is indicated by the letter following the insect symbol:

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1976
FOREST INSECT AERIAL SURVEY
MAPPING LEGEND
OKANQGAN NF

SYMBOL

1	Douglas-fir beetle
3	Engelmann spruce beetle
4	Fir engraver
6L	Mountain pine beetle
6P	Mountain pine beetle
6W	Mountain pine beetle
8	Western pine beetle

HOST

Douglas-fir
Engelmann spruce
True firs
Lodgepole pine
Ponderosa pine
Whitebark pine
Ponderosa pine

BARK BEETLES

Douglas-fir beetle
Engelmann spruce beetle
Fir engraver
Mountain pine beetle
Mountain pine beetle
Mountain pine beetle
Western pine beetle

HOST

Western spruce budworm
WSBW sample plot

Douglas-fir
True firs
Spruce

Beetle damage mapped by insect symbol and number of trees.

SYMBOL

BS
★

Insect damage mapped by intensity and the intensity of damage is indicated by the letter following the insect symbol:

L = Light

M = Moderate

H = Heavy

1976
REST INSECT AERIAL SURVEY
MAPPING LEGEND
OKANOGAN NF

BARK BEETLES

<u>SYMBOL</u>	<u>BARK BEETLES</u>
1	Douglas-fir beetle
3	Engelmann spruce beetle
4	Fir engraver
6L	Mountain pine beetle
6P	Mountain pine beetle
6W	Mountain pine beetle
8	Western pine beetle

Beetle damage mapped by insect symbol and number of trees.

DEFOLIATORS

Western spruce budworm
WSBW sample plot

Insect damage mapped by intensity and the intensity of damage is indicated by the letter following the insect symbol:

L = Light

M = Moderate

H = Heavy

